

# Research Project Proposal - Alzhemist

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## Summary of the Proposal

We propose a research project for image classification for Alzheimer's Disease(AD). The current research in Machine Learning(specifically Deep Learning) is focused on Convolution Neural Networks(CNN). We propose an alternate model(so-called Alz-Janus) which is a combination of CNN and Vision Transformers[4][5].

## Background

Alzheimer's Disease(AD) is a progressive neurodegenerative disorder that effects memory, thinking and behavior. The general hypothesis regarding AD is that it prevents internal parts of cells of brain from running well.

In the Brain MRI data of people diagnosed with AD, two abnormal structures can be seen - called plaques and tangles which are believed to be the prime suspects in damaging and killing brain cells. The exact role of these structures is unknown, but there is a correlation between these structures and diagnosis of AD.

- Plaques are deposits of protein fragment called Beta-Amyloid that builds up in the spaces between nerve cells.
- Tangles are twisted fibres of protein called tau that builds up inside the cells.

People diagnosed with AD tend to develop far more of these abnormal structures and that too in a predictable pattern - beginning in the areas important for memory and then spreading to other parts of the brain.

Our aim is to classify these abnormal structures by using Machine Learning on the Brain MRI data. We have hypothesized to develop a location specific model(CNN with Vision Transformer) to pinpoint the location of these abnormal structures in the MRI data. A robust model can even be used to detect Early Onset AD. Our aim is just that - to correctly identify and classify the MRI data<sup>1</sup>.

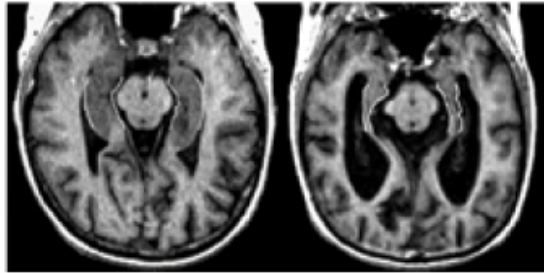


Figure 1: MRI Image courtesy of Sunnybrook and Women's College of Health Sciences Center

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\*contributed in analyzing Brain MRI data from biological perspective

<sup>1</sup>The github repository for the project can be found at: [1]

## Goal and Objectives

The goal of this project is to develop and serve this model for any future applications that might use it. With more data, our model can also be used in diagnosis of AD by medical practitioners. The Alz-Janus Model(similar in architecture to ConViT[3]) for image classification hasn't been used in the field of medical intelligence before. If the project is approved, further data can be accessed through University of Southern California Image and Data Archive[2], amongst other sources. We hope our research can help in diagnosis of AD in an accurate, trustworthy and reliable way.

## References

- [1] Alzhemist GitHub Repository. <https://github.com/yash-srivastava19/Alzhemist>.
- [2] USC - Image and Data Archive. <https://ida.loni.usc.edu/login.jsp>.
- [3] Stéphane d'Ascoli, Hugo Touvron, Matthew Leavitt, Ari Morcos, Giulio Biroli, and Levent Sagun. Convit: Improving vision transformers with soft convolutional inductive biases. *arXiv preprint arXiv:2103.10697*, 2021.
- [4] Alexander Kolesnikov, Alexey Dosovitskiy, Dirk Weissenborn, Georg Heigold, Jakob Uszkoreit, Lucas Beyer, Matthias Minderer, Mostafa Dehghani, Neil Houlsby, Sylvain Gelly, Thomas Unterthiner, and Xiaohua Zhai. An image is worth 16x16 words: Transformers for image recognition at scale. 2021.
- [5] Ashish Vaswani, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N. Gomez, Lukasz Kaiser, and Illia Polosukhin. Attention Is All You Need, 2017.